ENGINEERING OUTLOOK

AT THE UNIVERSITY OF ILLINOIS

RESEARCH
EDUCATION
PUBLIC SERVICE

UNIVERSITY OF ILLINOIS BULLETIN · COLLEGE OF ENGINEERING · ENGINEERING EXPERIMENT STATION VOL. 2, NO. 10, DECEMBER 1961

UNIVERSITY OF ILLINOIS
LIBRARY
JAN 3 1962
CHICAGO

PARTNERS IN PURE RESEARCH

In the last few years industry has paid increased attention to fundamental research. To some extent this has been caused by the fact that applied research, traditionally the province of industry, is approaching the boundaries of theoretical knowledge, the product of fundamental research in the university. The result has been a trend toward increased basic research interaction between industries and universities where each side contributes what it can do best. A good example of this sort of project is a cooperative study of the fundamentals of superconductivity by the University of Illinois College of Engineering and Fansteel Metallurgical Corporation of North Chicago, Illinois.

Superconductivity, which was discovered fifty years ago, can be most simply defined as the disappearance of all electrical resistivity in certain metals at temperatures near absolute zero (−459° F.). Metals which exhibit this phenomenon are called superconductors. Some of the better known ones are niobium, lead, tin, mercury, aluminum, tantalum, and vanadium. Most superconducting metals (except aluminum) are not particularly good conductors at normal temperatures; most metals which are ordinarily good conductors, such as copper, silver, or gold, do not become superconductors at any temperature. For reasons not yet fully understood, the electrical resistance of superconducting metals drops to less than 10^{-15} of its normal value when the metal attains the superconducting state. Electric currents then apparently flow forever.

Applications are not the primary concern of researchers working on this project, although superconductivity shows much promise in such areas as electromagnetism, the creation of magnetic fields to contain thermonuclear plasmas, and the efficient transmission of electricity. The Fansteel Corporation is interested in the potentialities of superconductors but is aware that fundamental, rather than applied, research is needed to solve the problems now restricting these applications. In joining forces with the University of Illinois, the Fansteel Corporation makes available its knowledge and ability to produce superconductor materials. The University, on the other hand, brings to the partnership its excellent cryogenic laboratory and a group of outstanding research specialists. The laboratory has facilities for cooling these materials to within a few hundredths of a degree of absolute zero. The specialists in the field of superconductivity include Dr. John Bardeen of the Physics and Electrical Engineering Departments, Dr. J. R. Schrieffer of the Physics Department, and Dr. C. B. Satterthwaite of the Coordinated Science Laboratory. Dr. Bardeen and Dr. Schrieffer are eminent authorities in this field who, in conjunction with Dr. L. N. Cooper, authored the fundamental theory of superconductivity which underlies much of the work now being done in the field. Dr. Satterthwaite conducted fundamental research in this area at Westinghouse before joining the University's Coordinated Science Laboratory.

According to Dr. Satterthwaite, this venture of planned cooperation in basic research between the U of I and Fansteel is the kind of partnership between universities and industries that will cut the fundamental Gordian knots that always stand in the way of practical engineering applications.

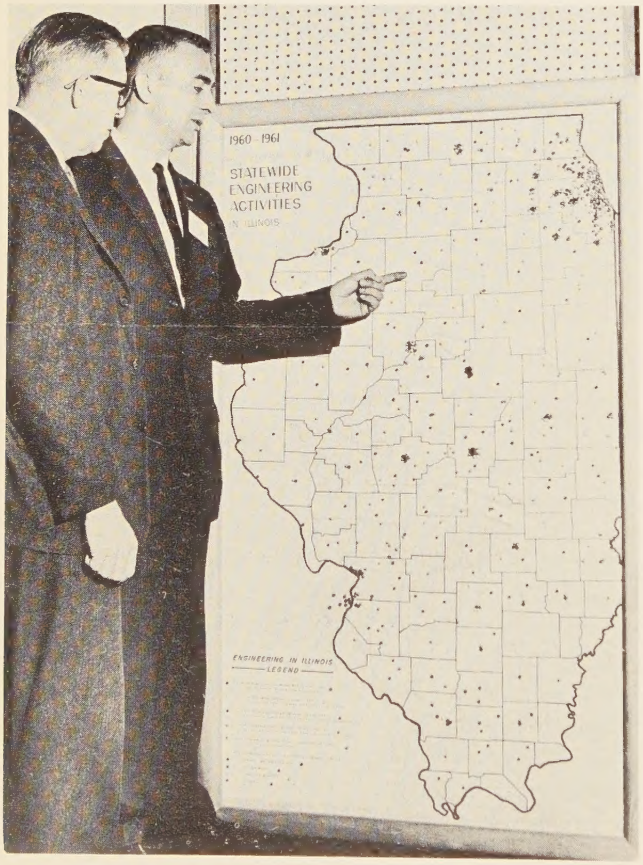
ACROSS THE STREET AND INTO THE IONOSPHERE

The ionosphere, the protective shield of gases surrounding our planet, burns up earth bound meteors, absorbs death dealing cosmic radiation, and permits long range radio communication. How many questions are yet unanswered about this electrically charged region is suggested by the recent ionospheric rocket probes and by satellites like Explorer VIII. Another indication of the interest in the ionosphere and in basic gaseous research is a recent $60,000 facility grant by the National Science Foundation to the University of Illinois Electrical Engineering Department to apply to the construction of a $187,000 Gaseous Electronics Laboratory. This new facility will permit more effective use of the group's half-million dollar annual research budget.

Because scientists and engineers can't conveniently conduct prolonged experiments in the ionosphere, all possible work should be done on the ground. Most of the attention of the University of Illinois group is now being placed on electromagnetic wave interaction techniques, high-temperature plasma studies, and other areas of gaseous electronics, but an important element of their work is understanding more about the nature of gaseous matter similar in make-up to the earth's ionosphere.

Researchers in the University of Illinois Gaseous Electronics Laboratory have always been interested in "space" — in fact, one of their most pressing problems has been a lack of it in their own laboratories. Next spring, directly across the street from the present engineering campus, they will have a building that will solve most of the ground level "space" problems and will aid them in their efforts to answer the many questions raised about space far above.

Mr. David Reyes-Guerra, Instructor in General Engineering and Illinois state director for the Junior Engineering Technical Society (JETS), points out present locations of Illinois JETS chapters and scenes of other 1960-61 University of Illinois engineering activities in Illinois to Dr. Richard T. Fallon of New York City, Executive Director of the JETS program. Both men spoke on state and national activities of JETS at the Engineering Alumni Committee Annual Meeting, November 3 and 4.



BULLETIN 461 AVAILABLE

Engineering Experiment Station Bulletin 461, *Effect of Heat Treatment and Chemistry on the Properties of Low Density Iron Base Sinterings,* by D. H. Boone and E. J. Eckel, is now available for distribution. Steel parts of controlled porosity and accurate shape can be produced by compressing and heat treating iron base powders. This bulletin deals with an evaluation of the variables associated with the development of high strength and ductility in low density parts. A common use for the internal porosity involves impregnation of the parts with oil for lubricating purposes. The price of the 40-page bulletin is one dollar per copy.

A CERAMIC ENGINEER BY ANY OTHER NAME . . .

There are as many definitions for engineering as there are people to make them. The various branches of engineering are even harder to characterize accurately, and ceramic engineering is perhaps the most difficult field of all to describe with precision. This has been one of the jobs undertaken by the High School Science Adviser Program, a project set up three years ago by the University of Illinois Department of Ceramic Engineering to assist Illinois high school science advisers in counseling their students.

On the Science Adviser Program's third anniversary, Dr. A. L. Friedberg, director of the project since its inception in 1958, said: "The success of this program must be attributed to the excellent cooperation of the science advisers of Illinois high schools. Although these are busy people, they have taken their time to give us the names of high school students who have indicated an interest in ceramic engineering and are qualified to enter engineering college. After receiving these names we have contacted each student, offering him information about ceramic engineering and inviting him to visit us. The program has been responsible in large measure for our increase in enrollment in the last three years."

Dr. Friedberg also said that one of the most interesting aspects of the Science Adviser Program is attempting to tell the high school students and their advisers what really characterizes ceramic engineering. "Today different people see the field in many different ways," he said, "depending on their own particular relationship to it. Ceramic engineers and researchers work in many diverse areas. To many of those familiar with the field, ceramic engineering means the product areas of large industries such as glass, cements, refractories, structural clay products, whitewares and porcelains, and ceramic coatings; but today ceramic materials are used for many new applications such as the fabrication of nuclear reactor fuel, coatings for rocket nose cones, electronic components, and special refractories to contain the ultra-high temperatures of modern manufacturing. The ceramic engineer is directly responsible for the development of this broad field of engineering and its relationship to other disciplines."

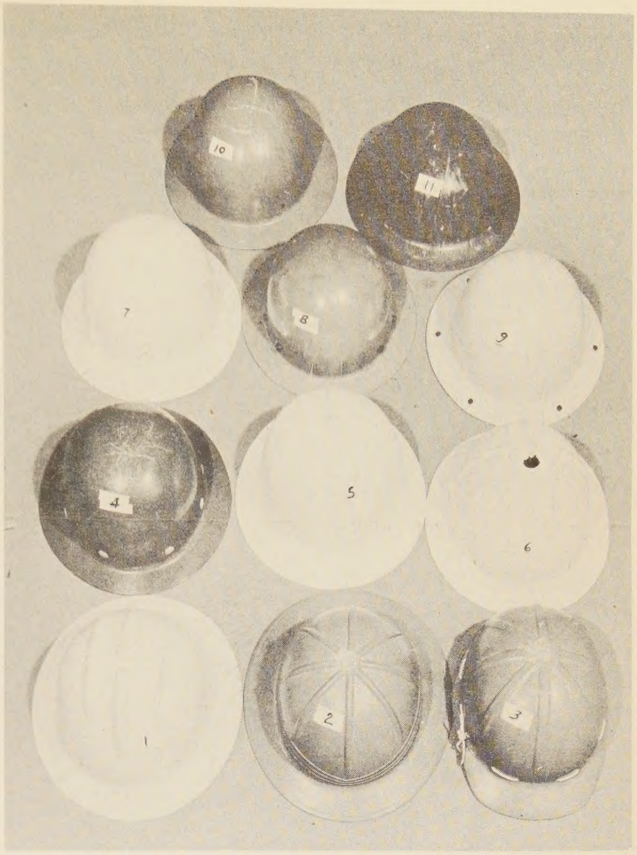
Ceramic engineering is an occupation with a thousand names and a thousand faces. It is generally defined by University of Illinois ceramic engineers as "the field of application of non-metallic, inorganic materials that are related to high temperatures, either in their processing or their uses." It is keeping pace with so many disciplines, they point out, that it would be an injustice to define it more specifically.

ARE "SAFETY" HELMETS SAFE?

The recently published results of a 1959-60 investigation at the University of Illinois suggests that the "safety" of some safety helmets may be more psychological than real. The tests, conducted by the Mechanical and Industrial Engineering and the Theoretical and Applied Mechanics Departments, have uncovered many faults in eleven plastic and Fiberglas safety helmets now on the market. The helmets tested, each bearing a number, are shown in the photograph. Although federal specifications call for a 40-foot-pound test, a number of the helmets ruptured in much less severe impacts. In no case were more than 40 foot-pounds of energy applied, and yet seven of the helmets were unable to withstand the tests. Three of them (numbers 4, 6, and 10) ruptured after several blows of only 24 foot-pounds of energy. This portion of the study was directed by G. W. Harper, Professor of Mechanical Engineering.

Tests of the helmet suspension systems were directed by C. E. Bowman, Professor of TAM. Only two of the eleven helmets (numbers 7 and 10) were stable when hit from the side. The rest would swing to the side abruptly, bottoming the helmet on the head form. Some of the fasteners which connected the suspensions to the helmets failed in these tests, allowing the helmets to fly off of the headform. Two helmets, numbers 8 and 9, failed in this way, preventing the completion of impact tests.

In the analysis of the design of the helmets, the investigators concluded that abrupt reinforcing ridges on helmets may concentrate the impact stresses on small areas of the shell and cause early fractures; and that helmets with smooth shells or slight ridges are often better designs because they distribute the impact stresses more evenly over the shell.



It appears that a great deal of study is going to have to be done before a safety helmet is produced that is truly stable, ductile, and adequately protective. Until it is, many construction workers are going to have protection that is more mental security than real safety. However, in recent months several manufacturers have produced modifications of both suspensions and helmet materials that may indicate an effort to meet this need. Although these recent models have not been tested, full test data on the helmets shown in the photo are given in a departmental report available upon request from Prof. G. W. Harper, 234 Mechanical Engineering Building, University of Illinois, Urbana, Illinois.

ENGINEERING SEMINARS AND DISCUSSION CALENDAR

Engineers and others in industry have indicated an interest in participating in engineering seminars and other engineering meetings on the Urbana campus. In response to this interest and to foster greater interaction between the College of Engineering and industry of Illinois and the Midwest, the Engineering Publications Office will begin publishing in January a weekly calendar listing topics, speakers, dates, times, and places of seminars, symposia, and other technical sessions open to visitors.

Copies of the calendar, which will be mailed free, are available upon request from the Engineering Publications Office, 112 Civil Engineering Hall, University of Illinois, Urbana, Illinois.

The facilities and faculty of the University of Illinois Department of Aeronautical and Astronautical Engineering are being put to good use by members of the newly chartered Student Chapter of the American Rocket Society. Professor H. S. Stillwell (right), Head of the Department, looks on as Professor S. M. Yen (left), faculty sponsor to the Chapter, discusses a Falcon rocket with two Society members. Robert Spitzer, Chapter Treasurer, supports the nose of the rocket. Beside him stands George Carruthers, Chapter President.

NEW COMPUTER FOR CSL

Research on computer applications by the University of Illinois' Coordinated Science Laboratory has been aided by the arrival of a large, high-speed digital computer made possible by a $990,000 grant from the Department of Defense. The machine selected by CSL is a Control Data Corporation 1604, a transistorized computer with a magnetic core memory capacity of 32,000 words. It is operating in a temporary location near the campus until permanent quarters can be prepared in the main CSL laboratory building.

Like other research organizations, the Coordinated Science Laboratory uses computers as a tool in research calculations. Some of its most notable achievements, however, have been in the development of new computer applications, particularly in the area of real-time decision making.

Beginning its University activities as the defense-oriented Control Systems Laboratory, CSL has done much research on military electronic control systems. Among these projects was the development of automatic threat evaluation and weapons assignment techniques for a Navy tactical data system. Another project in the military application area was a study of relationships and interactions between human and computer control (*Engineering Outlook,* September, 1960).

Today CSL is still supported largely by the three military services, but greater emphasis is being placed on fundamental research, with less orientation toward work with immediate military application. Its computer applications work now includes such projects as the PLATO teaching machine (*Outlook,* April, 1961). The new 1604 will be particularly useful for these projects, as well as for research in such areas as decision making, adaptive control systems, physics of surfaces, and plasma physics.

ENGINEERING OUTLOOK is published ten times a year by Engineering Publications, 112 Civil Engineering Hall, University of Illinois, Urbana. Subscriptions without cost are available upon written request. Material may be reproduced without permission, although credit to the source is appreciated. *Engineering Outlook* Editor: R. Alan Kingery. Engineering Experiment Station Editor: Paul T. Bryant. Director of the Engineering Experiment Station: Ross J. Martin. Dean of the College of Engineering: William L. Everitt.

UNIVERSITY OF ILLINOIS BULLETIN

Volume 59, Number 30; November, 1961. Published nine times each month by the University of Illinois. Entered as second-class matter December 11, 1912, at the post office at Urbana, Illinois, under the Act of August 24, 1912. Office of Publication, 49 Administration Building (West), Urbana, Illinois.

VOL. 2, NO. 10, DECEMBER 1961

ENGINEERING OUTLOOK
112 CIVIL ENGINEERING HALL
UNIVERSITY OF ILLINOIS · URBANA

SECOND CLASS
POSTAGE PAID AT
URBANA, ILLINOIS